§ 28.570 Intact righting energy.

(a) Except as provided in paragraph (c) of this section, each vessel must have the following properties in each condition of loading:

(1) An initial metacentric height (GM) of at least 1.15 feet (0.35 meters);

(2) A righting arm (GZ) of at least 0.66 feet (0.2 meters) at an angle of heel not less than 30° (0.52 radians);

(3) A maximum righting arm that occurs at an angle of heel not less than 25° (0.44 radians);

(4) An area under each righting arm curve of at least 16.9 foot-degrees (0.090 meter-radians) up to the lesser of 40° (0.70 radians) or the angle of downflooding;

(5) An area under each righting arm curve of at least 10.3 foot-degrees (0.055 meter-radians) up to an angle of heel of 30° (0.52 radians);

(6) An area under each righting arm curve of at least 5.6 foot-degrees (0.030 meter-radians) between 30° (0.52 radians) and the lesser of 40° (0.70 radians) or the angle of downflooding; and

(7) Except as provided by paragraph (b) of this section, positive righting arms through an angle of heel of 60° (1.05 radians).

(b) In lieu of meeting the requirements of paragraph (a)(7) of this section, a vessel may comply with the following provisions:

(1) Hatches in the watertight/weathertight envelope must be normally kept closed at sea (e.g., the live tank hatch is only opened intermittently, under controlled conditions); or

(2) Unintentional flooding through these hatches must not result in progressive flooding to other spaces; and

(3) In all cases, a vessel must have positive righting arms through an angle of heel of at least 50° (0.87 radians) and the intact stability analysis must consider that spaces accessed by such hatches to be flooded full or flooded to the level having the most detrimental effect on stability when free surface effects are considered.

(c) In lieu of meeting the requirements of paragraph (a) of this section, a vessel may comply with the provisions of § 170.173(c) of this chapter, provided that righting arms are positive to an angle of heel of not less than 50° (0.87 radians).

(d) For the purpose of paragraphs (a) and (c) of this section, at each angle of heel a vessel's righting arm must be calculated assuming the vessel is permitted to trim free until the trimming moment is zero.

§ 28.575 Severe wind and roll.

(a) Each vessel must meet paragraphs (f) and (g) of this section when subjected to the gust wind heeling arm and the angle of roll to windward as specified in this section.

(b) The gust wind heeling arm, L_w in figure 28.575 of this chapter, must be calculated by the following formula:

$$K\ E_n(V_n 2A_n Z_n)/W,$$

where:

K=0.00216 when consistent English units are used or 1.113 when consistent metric units are used.

E_n=series summation notation where n varies from 1 to the number of elements in the series;

V_n=S[0.124LN(0.3048h_n)+0.772], in feet per second S[0.127LN(h_n)+0.772], in meters per second and is the wind speed for profile element ''n'' on a vessel;

S=64 (19.5, if metric units are used) for a vessel that operates on protected waters; or 85.3 (26, if metric units are used) for a vessel that operates on waters other than protected waters;

LN=natural logarithm;

h_n=the vertical distance from the centroid of area A_n to the waterline for profile element n, in feet (meters);

A_n=projected lateral area for profile element n, in square feet (square meters);

Z_n=the vertical distance between the centroid of A_n and a point at the center of the underwater lateral area or a point at approximately one-half of the draft, for profile element n, in feet; and

W=displacement of the loaded vessel, in pounds (Newtons).

(c) The angle of roll to windward, A_1, is measured from the equilibrium angle, A_{el}, and is calculated by the following formula:

A_1=109kXY[Square root of (rs)], in degrees,

where:

s,X,Y=factors from table 28.575;

r=0.73+0.6 Z_g/d;

Z_g=distance between the center of gravity and the waterline (+ above, − below), in feet (meters);

k=1.0 for round bilged vessels with no bilge keels or bar keels; 0.7 for vessels with sharp bilges, or the value from table 28.575

for vessels with a bar keel, bilge keels, or both;
B=molded breadth of the vessel, in feet (meters);
d=mean molded draft of the vessel, in feet (meters);
C_b=block coefficient;
A_k=aggregate area of bilge keels, the area of the lateral projection of a bar keel, or the sum of these areas, in square feet (square meters);
L=length, in feet (meters);
T=1.108 BC/square root of GM, in seconds; 2.0 BC/square root of GM, if metric units are used;
GM=metacentric height corrected for free surface effects, as explained in §28.540, in feet (meters);
C=0.373+0.023(B/d)−0.000131L or 0.373+0.023(B/D)−0.00043L, if metric units are used.

(d) The angle of equilibrium, A_{el} in figure 28.575, is calculated by determining the lowest angle at which the gust wind heeling arm, L_w, is equal to the righting arm.

(e) The area ''b'' in figure 28.575 must be measured to the least of the following:

(1) The angle of downflooding, (A_f);

(2) The angle of the second intercept, A_{e2} in figure 28.575, of the wind heeling arm curve, L_w in figure 28.575, and the righting arm curve; or

(3) A heel angle of 50° (0.87 radians).

(f) The angle of equilibrium, A_{el} in figure 28.575, must not exceed 14° (0.24 radians).

(g) Area ''b'' in figure 28.575 must not be less than area ''a'' in figure 28.575.

TABLES 28.575—ROLL FACTORS

B/d	X
2.4	1.0
2.5	0.98

TABLES 28.575—ROLL FACTORS—Continued

B/d	X
2.6	0.96
2.7	0.95
2.8	0.93
2.9	0.91
3.0	0.90
3.1	0.88
3.2	0.86
3.3	0.84
3.4	0.82
3.5	0.80

Note. Intermediate values must be obtained by interpolation.

C_b	Y
0.45	0.75
0.50	0.82
0.55	0.89
0.60	0.95
0.93	0.97
0.70	1.0

Note. Intermediate values must be obtained by interpolation.

$100A_k/(LB)$	k
0	1.0
1.0	0.98
1.5	0.95
2.0	0.88
2.5	0.79
3.0	0.74
3.5	0.72
4.0	0.70

Note. Intermediate values must be obtained by interpolation.

T	S
6	0.100
7	0.098
8	0.093
12	0.065
14	0.053
16	0.044
18	0.038
20	0.035

Note: Intermediate values must be obtained by interpolation.

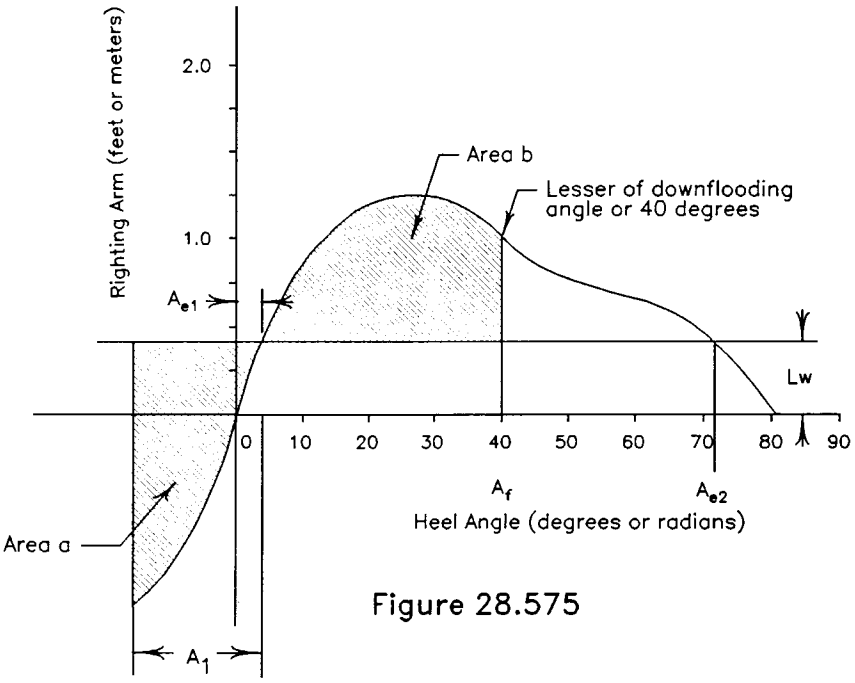

Figure 28.575

[56 FR 40393, Aug. 14, 1991, CGD 88–079; 56 FR 47679, Sept. 20, 1991, CGD 88–079, as amended by CGD 95–072, 60 FR 50461, Sept. 29, 1995; USCG-2004–18884, 69 FR 58344, Sept. 30, 2004]

§ 28.580 Unintentional flooding.

(a) *Applicability.* Except for an open boat that operates on protected waters and as provided by paragraph (i) of this section, each vessel built on or after September 15, 1991 must comply with the requirements of this section.

(b) *Collision bulkhead.* A watertight collision bulkhead must be fitted and must meet the following:

(1) Openings in the collision bulkhead must be kept to a minimum, and each must be fitted with a watertight closure device;

(2) A collision bulkhead must not be fitted with a door below the bulkhead deck;

(3) A penetration or opening in a collision bulkhead must be—

(i) Located as high and as far inboard as practicable; and

(ii) Fitted with a means to rapidly make it watertight which is operable from a location aft of the collision bulkhead;

(4) The collision bulkhead must be located at least 5 percent of the length from the forward perpendicular unless the vessel has a bulbous bow, in which case the forward reference point will be extended by half the distance between the vessel's forward perpendicular and the forwardmost point of the bulbous bow as shown in figure 28.580; and

(5) The collision bulkhead must not be stepped below the bulkhead deck.

(c) Each vessel must meet the survival conditions in paragraph (f) of this section in each condition of loading and operation with the extent and character of damage specified in paragraphs (d) and (e) of this section.

(d) *Extent and character of damage.* Except where a lesser extent of damage or a smaller penetration would be more disabling, in evaluating the damage